UDC: 004.81; 159.92 https://doi.org/10.15407/jai2023.01.088

MODES OF PSYCHO-INFORMATIONAL INTERACTION OF A HUMAN OPERATOR WITH TECHNICAL, INFORMATION AND INTELLECTUAL SYSTEMS

A. Bukalov
International Institute of Socionics, Ukraine
12, Illenko str., Kyiv, 04050
123@socionic.info
https://orcid.org/0000-0002-6586-7225

Annotation. A decrease in the attention of the operator or his incorrect reaction during prolonged interaction with the technical system is one of the most serious problems. From the point of view of the theory of information metabolism of the psyche - socionics - this means that the human psyche does not receive adequate information signals that support its necessary working state, concentration of consciousness, level of attention, etc. The solution to this problem is connected with the definition of the information characteristics of the technical system and with the construction of adequate information interaction in the integral complex "operator - technical system". It is achieved by using the method of socionical analysis and modeling.

Knowledge the information structure of a technical system gives opportunity to predict a number of features of its behavior. It gives additional significant information about the parameters that must be taken into account for adequate monitoring of the system's behavior.

The second task is related to the form of providing the system with signals to the operator for the subsequent adequate reaction. A human operator has a certain type of information metabolism, and receiving information on some informational aspects is familiar and convenient for him, but on the other is associated with tension.

To solve this problem there are identified and considered 16 possible specific modes of psycho-informational interaction of a human operator as a carrier of a certain socionic type of information metabolism with technical or electronic systems, including artificial intelligence systems. These modes can be complementary, resonant, neutral or non-complementary. The specificity of psycho-informational interaction is certainly important from the point of view of efficiency and safety.

Keywords: psycho-informational interaction, type of informational metabolism, artificial intelligence.

Introduction

The human interaction with the technical and electronic systems, including artificial intelligence systems, is an aspect of the more general problem, referring to the human interaction with environment: social, natural, artificial or combined. In many features this interaction is determined by the information interaction of a human as a carrier of certain information metabolism type (IMT) with this environment: the reception and processing of information signals [3, 6], their interpretation, the decision adoption and actions. The appearance of complex technical systems, including the artificial intellect elements, made this problem more actual. The interaction adequacy in the complex "operator-system" influences not only on the effectivity of the system processing, but also has a danger, connected with the accidents under the operation of transport systems, energetics (especially nuclear) objects, military (especially rocket) systems. The disbalance under the operator-system interaction causes the possibility of the inadequate interpretation of the system behaviour by operator what can be a cause for a breakdown.

The other variant — the essential difference of the information structure of signals, given by the system to the control desk, from those ones, which are suitable for the certain operator psychics. Such a difference, despite the professional training, can cause the tiredness, the attention reduction and, as a result, the mistake, the operation quality reduction, what rises the breakdown probability.

Statement of the problem

One of the serious problems is the operator attention reduction under the long work. From the point of view of the information metabolism theory — the socionics, created in 1970-80s by A. Augustinavichute [1–1], — it means that

the human psychics does not receive the adequate information signals, supporting his necessary working condition, consciousness concentration, attention level etc. Thus, the similar problems decision reduces to the two tasks:

1) The determination of the technical system information characteristics.
2) The adequate information interaction of a human with this system.

Analysis of the latest research and publications

A number of studies have been carried out in this direction. Using the socionic psycho-informational theory of interactions and relationships, the author described aspects of the interaction of a person - an operator or a dispatcher with complex process control systems at enterprises, as well as in transport [2].

To predict the development of technical devices based on the use of the model proposed earlier by Augustinavichute A., a model of the human-machine system (HMS) was proposed. This generalized model consisting of 4 blocks. Each block, in turn, consists of two other sub-blocks called "technical functions": the first technical function is the goal, the second technical function is the way to achieve it. Each block and technical function in the model is interconnected and has its own purpose and orientation [8, 9]

In the development of this direction, within the framework of aviation socionics, which has been developing since the late 1990s, the issue of information interaction of the pilot and crew with the technical means (aircraft) with the analysis and modeling of these processes is at the forefront.

There are considered:

- socionic model of the person;
- socionic model of a crew member;
- the crew as a collective operator;
- socionic characteristics of the crew;
- quantitative assessment of the effectiveness of interaction;
- conditions for achieving synergy;
- predictive socionic characteristics of the crew;
- socionic model of intertype relations;
- socionic model of the crew and its calculation;
- the use of the socionic model of intertype relationships;
- the formation of an effective team;
- the problem of assessing the interaction between human and technology;
- assessment of interaction in the system "pilot – aircraft" and criteria for assessing;
- socionic aspects of the interaction of the pilot with the aircraft;
- prevention of pilot errors by constructive and technological measures".

In experimental studies of employees of the National Aviation University and the State Flight Academy of Ukraine [10, 11], it was also shown that "the use of sociometric and socionic approaches to the recruitment of flight crews and dispatch teams play an important role in the work of aviation specialists.

The practical value of the research lies in the development of an automated module for determining the individual socionic characteristics of operators and evaluating the effectiveness of their interactions in the process of air traffic control, in particular, in special cases of flight" [10, 11].

Such significance of the topic under consideration is also due to the fact that mental functions and specialized types of informational metabolism (which interact with each other form an integral microsocial system – socion [1]) have been formed in the process of evolution for the most effective orientation in various aspects of the surrounding world, the natural and social environment, and for quick decision-making for the survival of both an individual and society as a whole [5] .

The purpose of the study

The first task implies that it is possible to determine the information type complex "operator-technical system" as a unit. Such a task is resolved by the socionics methods [2–4]. More than that, knowing the system information type, it is possible to predict some features of its behaviour, which were not foreseen under its projecting. It gives the knowledge of those parameters, which have to be taken into account for the adequate following of the system behaviour.

The second task is connected with the

form of the system signals presentation to the operator for the subsequent adequate reaction. The human-operator has certain type of information metabolism and the information reception by some information aspects is usual for him and adequate while for the other ones it is connected with a tension, sometimes rather essential. For example, the introvert intuitive type LII or EII with a weak will sensorics (or a real sensorics) under the necessity of the fast decision adoption in the variable condition can probable adopt an unadequate decision according to the information one-dimension feature of sensor function. One the contrary, the sensor extraverts SLE and SEE actions are the most adequate in such a condition, because the function of the sensor reality estimation for these types is four-dimentions [3, 7]. Such investigation with the socionics usage were carried out in aviation [10, 11].

It is known that the irrational operators work perfectly in the variable situation and badly do the routine work. On the contrary, the rational types are more stable and have a possibility to routine work but they dislike the surprises: the "irrational" unstable behaviour of a system makes a harmful influence on their psycho-physiological condition.

Thus the system behaviour as well as the information presentation about its condition have to correspond to the operator type or the operators group types.

Presentation of the main material

As the socionics point out the 16 IM types and 16 kinds of intertypes interactions [3, 7], it is possible that between system and operator in the general case there are 16 regimes of information interaction as well as these regimes combinations.

1. "Duality" regime: the information is presented in the most pleasant and understood form, according to the information aspects of the 5th and 6th functions (SuperId) of the operator. The regime is suitable for the long work.

2. "Activation" regime: the information is presented mainly by the aspects of the block operator SuperId, whereas the 6th function aspect prevails by the 5th one. Such a regime provides to reveal the covered resources of the system and activates the operator attention.

3. "Identity" regime: the presented information corresponds to the EGO operator's function, mainly to the first, then to the second. It is the regime of the deep and maximal precise interaction with system.

4. "Mirror": the presented information corresponds to the EGO functions information aspects, mainly to the second and then to the first. The regime is optimal for the correction of the system work as a unit.

In the regimes 1–4 the operator adequately interacts with the system.

5. "Benefactor": the system obeys the operator but reveals the "own" behaviour, the given information is not completely clear to operator, because it is presented by the 6th and 7th operator functions. The operator interacts with the system not rather adequate. The system behaviour is not predictable for him.

6. "Supervisor": the presented information is not rather adequate, the system behaves itself regulary more independently, than the operator implies, and thus such an interaction causes a serious irritation and trouble. The system behaviour is not predictable for operator.

7. "Business": the information is presented by the third and second functions of the operator information metabolism. The system has more degrees of freedom compared with the third operator IM function. The system behaviour is not completely predictable.

8. "Mirage": the information is presented by the 7th and 8th aspects of IMF. The operator has an illusion that he understands the system behaviour but it is not so. Under this situation the system remains rather operated.

9. "Super-ego": the signals, presented by the system, corresponds to the SuperEgo operator block, they are more intensive, than the operator consciousness can keep, and thus he quickly becomes tired.

The 6-9 regimes are characterized by the partly adequate information interaction with the system.

10. "Conflict": the same situation as in 9, but the presented information is not completely adequate to the operator

perception; an attempt to operate causes the more chaos.

The 9 and 10 regimes are valid for the system work check-up under the extreme condition and for the covered defects detection.

11. “Quasi-identity”: the information signal is presented by the IMF of the ID operator block and is understood only partly by him. The operator seems that he adequate interacts with system, feels it, until it occurs that in some important moment the system behaves by some other way, than he expects, what causes the unpredictable results.

12. “Extinguishment” of “put out”: the presented information by the 7th or 8th functions of the ID operator block is inadequate to his perception. The system and operator actions are in “antiphase”, the operation in such regime reduces the system and operator works effective till to the blocking of the system function (regime is suitable for the system stop).

13. “Request recipient” regime system-operator. The presented information acts mainly on the 5th and 8th operator functions and stimulates his activity, but the operator acts by the function of his block EGO. The system behaves by its own way. The operator has only to follow its functioning. The system rules the operator behaviour, which can only put some little changes in its work.

14. “Semi-duality” regime: the information is presented mainly by the 5th and 8th operator functions IM in the form, adequate for perception.

15. “Supervisee” regime system-operator: the information from the system is presented mainly by the 4th than by the 1st IM function. The information by the 4th function enhances the operator possibilities, what causes the psychosomatic tension and increases the error possibility. The system rules the operator, its reaction on the operator actions is slightly predicted.

16. “Kindred” regime: the information is presented mainly by the 1st and 4th operator functions. The operator perceives almost adequate image about the current system condition but the attempt to rule causes a disbalance: the system can behave by other way than the operator supposed.

All 16 regimes can be used for the interaction with a system in dependence of the certain aim, for example, for the operators training or the check of system. Meanwhile in reality the most optimal are the regimes №№ 1–4, 14, then №13 and №5, in special cases — the regimes №15 and №12. The most dangerous are the regimes №№10, 9, 6, sometimes №2. The enhanced danger is inherent to the regimes №№14, 15. The others regimes have the incomplete adequacy in interaction and the expedience of their usage is determined by the certain conditions and tasks. The periodical change of regimes can be useful for the support of the operator attention level.

In the general sense, it is a problem of the interaction of a human, socium and their electronics assistants: robots (industrial and house), information systems (including Internet), energy and life provision systems, i. e. the whole electronic artificial environment, including artificial intelligence systems, created by the humankind [2, 4].

It is obvious that the interaction with these devices, especially the house ones, has to be optimal from the psychological point of view. These devices have not to cause the feelings of discomfort, danger, dislike etc. At the same time the perception of the different types of information metabolism is rather different: something, pleasant for one person as a IM type, irritates another one. In this case it is arisen the necessity of the development of the electronic devices, either different, or including the adjusted system of behaviour and interaction with a human. Such problems, including the consideration of the set of the personal electronic assistants and sociological models, can be resolved by the methods of the classical and integral [3] socionics.

Conclusions

The mentioned set of problems includes the one, connected with the artificial intellect development and the interaction with it.

Socionics proves that it is impossible to develop the compete, effective intellect, using only the logical and sensoric functions. It has to include the all 8 (16) information aspects, including the functions of feeling, or emotions, and intuition. All these functions, as the information subsystems, have to be

within some relation and only in this case it is possible to speak about the unit integral intellect and not about its elements [3, 6]. Under the development of such integral artificial intellect it is arisen the problem of the interaction between the human and electronic types of information metabolism, which has to be taken into account and resolved by the methods of socionics and other sciences.

References

1. Augustinavichute, A. (1980) Informacinio metabolizmo modelis. *Mokslas ir technika*, (4).
2. Augustinavichute, A. (1996) The Socion. *Socionics, mentology and personality psychology*, (4-5).
3. Bukalov, A.V. (1999) Interaction between humans and technical systems viewed from point of the theory of informational metabolism *Socionics, mentology and personality psychology*, (6), 29–32.
4. Bukalov, A.V. (2009) *Potential of personality and the mysteries of human relationships*. M.: Chernaja Belka.
5. Bukalov, A.V. (2018) Psychoinformatics, socionics, and the creation of quantum computers of a new type. *Proc. of XIII Internat. Conf. on Applied Biophysics, Bionics and Biocybernetics*, 12.
6. Bukalov, A.V., Karpenko O.B (2018) Human evolution: the formation of the FIM structure and Socion. *Socionics, mentology and personality psychology*, (6), 5–17.
7. Bukalov, A.V., Karpenko O.B (2021) New aspects of mental processes modeling and creation of artificial intelligence. *XXI International Scientific and Technical Conference "Artificial intelligence and intelligent systems"*.
8. Bukalov, A.V., Karpenko, O.B. (2005) Socionics: the effective theory of the mental structure and the interpersonal relations forecasting. *Proc. of Conference of the British and East European Psychology Group "Psychology in the new Europe: methodology and funding"*, 28.
9. Bukalov, G.K. (1998) TIM of the Man-Object System. *Socionics, mentology and personality psychology*, (1), 39–42.
10. Bukalov, G.K. (2001) *Development of the theory of interaction of a textile product with thread-conducting working bodies and methods for increasing their wear resistance*.
11. Shmelova, T.F., Sikirda, Y.V., Sunduchkov, K.S. (2013) Socio-Technical Analysis of Air Navigation System. *Science and Technology of the Air Force of Ukraine*, 4(13), 34–39.
12. Sikirda, Y., Shmelova, T. (2018) Socionic and Sociometric Diagnosting of Air Navigation System's Operators. *Socio-Technical Decision Support in Air Navigation Systems: Emerging Research and Opportunities*, 108–137.

The article has been sent to the editors 25.10.22.
After processing 10.11.22.